R E P O R T R E S U M E S

ED 016 396 EM 005 969

TECHNOLOGY IN EDUCATION. EDUCATION U.S.A. SPECIAL REPORT.

BY- WILSON, ROY K. AND OTHERS

NATIONAL SCHOOL PUBLIC RELATIONS ASSN., WASH.,D.C.

PUB DATE 67

EDRS PRICE MF-$0.25 HC NOT AVAILABLE FROM EDRS. 27P.

DESCRIPTORS- *INSTRUCTIONAL TECHNOLOGY, *EDUCATIONAL INNOVATION, *STUDENT TEACHER RELATIONSHIP, INDIVIDUAL INSTRUCTION, EDUCATIONAL ADMINISTRATION, NATIONAL PROGRAMS, *DISADVANTAGED ENVIRONMENT, SCHOOL SYSTEMS, *COMPUTER ASSISTED INSTRUCTION, NEGRO STUDENTS, FINANCIAL PROBLEMS

THE POSSIBLE RESULTS AND IMPLICATIONS OF THE NEW TECHNOLOGICAL DEVELOPMENTS IN EDUCATION ARE DISCUSSED, WITH SPECIAL ATTENTION TO THE CURRENT STATE OF THE ART, TEACHER-STUDENT RELATIONSHIPS, EDUCATION IN SLUM AREAS, INDIVIDUALIZED INSTRUCTION, A MODERNIZED LEARNING SYSTEM, EDUCATIONAL ADMINISTRATION AND FUNDING ON THE NATIONAL LEVEL, NECESSARY ADJUSTMENTS IN THE EDUCATIONAL SYSTEM, AND THE NEGRO STUDENT. INFORMATION SOURCES ON EDUCATIONAL TECHNOLOGY ARE GIVEN. COPIES OF THIS DOCUMENT MAY BE ORDERED FROM THE NATIONAL SCHOOL PUBLIC RELATIONS ASSOCIATION, 1201 16TH STREET, N.W., WASHINGTON, D.C. FOR $1.50. (MS)

ED016396

"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL BY MICROFICHE ONLY HAS BEEN GRANTED BY Nat'l School Public Relations Assoc. TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U. S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

TECHNOLOGY IN EDUCATION

EDUCATION U.S.A. SPECIAL REPORT

New developments in technology herald an impending revolution in American education

This Is an EDUCATION U.S.A. Special Report

Since it was founded in 1958, *Education U.S.A.* has introduced some new dimensions to educational journalism in the United States. Its four-page weekly newsletter on education scans major developments in preschool to graduate level education. The editors select from hundreds of sources, including reports from their own correspondents in each state, what seems most significant or interesting for the newsletter's readers. The *Washington Monitor* section is a current report on activities at the U.S. Office of Education, Capitol Hill, and other federal agencies involved in education. Every year the editors prepare a special handbook of articles on trend-making subjects in American education, *The Shape of Education.*

Occasionally, the editors decide that some aspects of education are important enough to be covered in detail; and they concluded that the implications of the impending technological revolution in education, with its substantial financial investment and potential for upsetting the status quo, required a special report. *Technology in Education* is the third in a series of detailed reports. The first, the *AASA Convention Reporter,* was a full, yet concise, overview of the American Association of School Administrators annual meeting in 1966. The second, *School Boards in an Era of Conflict,* reported on the new and important research on the role of laymen in education, as presented at the 1966 Cubberley Conference, School of Education, Stanford University.

Education U.S.A. publishes weekly, September through May, and twice in the summertime. It is produced by the National School Public Relations Association, in cooperation with the National Education Association Division of Press, Radio, and Television Relations, 1201 16th St., N.W., Washington, D.C. 20036. Subscriptions are $18 a year.

This Special Report, *Technology in Education,* was produced by the staff of *Education U.S.A.:* Roy K. Wilson, Washington, D.C., Editorial Director; Mrs. Helen H. Cox, Washington, D.C., Managing Editor; Robert Olds, Santa Barbara, Calif., West Coast Correspondent; Joseph Hanlon, Mrs. Anne C. Lewis, Miss Patricia Platt, Washington, D.C., Editors; Mrs. Mildred S. Wainger, Washington, D.C., Circulation Manager; Miss Shirley Ann Boes, Washington, D.C., Production Manager.

Additional copies of *Technology in Education* may be ordered from the National School Public Relations Association, 1201 16th St., N.W., Washington, D.C. 20036. Prices: single copy, $1.50; 2 to 9 copies, $1.35 each; 10 or more copies, $1.20 each. Payment must accompany orders for $2 or less.

COPYRIGHT 1967 NATIONAL SCHOOL PUBLIC RELATIONS ASSOCIATION
THIRD PRINTING

Permission to reproduce this copyrighted work has been granted to the Educational Resources Information Center (ERIC) and to the organization operating under contract with the Office to Education to reproduce documents included in the ERIC system by means of microfiche only, but this right is not conferred to any users of the microfiche received from the ERIC Document Reproduction Service. Further reproduction of any part requires permission of the copyright owner.

EDUCATION U.S.A.

SPECIAL REPORT

TECHNOLOGY IN EDUCATION

THE TECHNOLOGICAL REVOLUTION IN EDUCATION

Education at all levels stands on the threshold of a major revolution which could transform the schools unbelievably. It has already begun, and is in evidence in schools all over the country. Electronics are in the foreground, but sloganeers who toy with the phrase "Gutenberg is dead" are in error. The textbook is still at hand and its place seems secure for the foreseeable future. But even textbooks have been transformed, in appearance, in content, and in production. Johann Gutenberg, who made them possible by his invention of movable type 500 years ago, would be amazed now to see page forms of type sprayed out of a sort of gun, not unlike the device painters sometimes use in painting a house. This revolution is like many others--where it will end nobody knows. How long it will be before adoption of its many new elements is anybody's guess. There are in the record predictions ranging from 3 to 20 years.

It will be fantastically expensive. Take, for instance, the talking typewriter, with which most schoolmen are familiar in at least general terms, although there are few in existence and the manufacturer expects to sell only about 100 of them in the next year. This is a programed device which has taught two-year-old children the elements of reading and writing. The child sits in front of a typewriter keyboard. He sees an image on the screen in front of him, a picture of a cow, for instance. He hears a recorded voice telling him it is a cow, and asking him to do something, punch the typewriter. The instrument responds only when the child, through trial and error, punches out the correct answer--c, o, and w. The talking typewriter, at current rates of production, costs a modest $35,000.

The computer leads the list. With one of these in a school library a student with the proper equipment can dial for whatever is stored in it, tape recorded lectures or films. He receives the information on something that looks like a small television set. A Midwestern university is said to have spent $500,000 for one such device. There is in the record an estimate that it would cost something between $100 million and $200 million--nobody really knows--to create such a system serving all public schools in New York State.

Many of the more complicated instruments are evolutions of the Defense Dept.'s astronomical expenditures for defense, or the exploration of space. Industries involved in the development of these instruments are turning their attention now to education. School expenditures are estimated at $48.8 billion for the 1966-67 fiscal year, which makes education the second biggest national market, ranking just behind defense. The big impetus for all this was the emergence of the federal government on the scene, largely through passage of the Elementary and Secondary Education Act of 1965. In any revolution as costly as this one is going to be, the federal government has a role to play. So has big industry. Foundations, also, have financed much of the innovation and will be called on for more.

WHERE WE ARE NOW

The director of the Center on Innovation in Education of the New York State Education Dept. probably has seen in actual operation in the nation's schools more technological advances than most educators. For more than two years that's been a large part of his job, and he has a fascinating story to tell. He is Norman D. Kurland and he told the story in the course of testimony during a brief series of hearings in June 1966 before the subcommittee on economic progress of the Senate-House Joint Economic Committee.

The subcommittee was inquiring into the whole question of how technology has affected and will affect education in the United States. Kurland's story of what he had seen around the country is best told in his own words.

"I have seen computers that present lessons to students in such a way that each student receives a lesson uniquely tailored to his needs. He controls the speed at which he moves through the lesson and his performance determines what the lesson will be. Where he has difficulty he gets help immediately; where he shows mastery he is moved ahead to more challenging materials. The presentation can be in written form, it can be by voice, it can be by pictures, moving or still, or any combination of these. The student makes his responses on a typewriter keyboard, by pressing buttons, or by pointing a light pen at a tube.

"The computer can provide the student with a printed record of his own progress in each lesson, or over any span of lessons. The teacher can get a similar record of progress, or a record on an entire class or any group within the class. She can get an analysis of the lesson itself to find out which parts are causing difficulty to which students. Changes can be made where difficulties are identified, and new materials can be added when called for. I have seen other computers on which children go through exercises that simulate real situations--running a government, doing chemical analysis, or choosing a career. Development of problem-solving and decision-making abilities are the special aims of such programs.

"I have seen a student dial into a central learning resources center and call up the lesson of his choice--a lecture on tape, a film, language instruction, music--anything indeed that can be stored photographically or electronically and transmitted electronically. I have seen 'talking typewriters' that help teach children and adults to read by creating a situation for learning to read that approximates that which makes learning to speak such a seemingly effortless experience for most children. I have seen beautifully prepared instructional materials--books, slides, transparencies, produced so inexpensively that there is no excuse for not supplying them to every classroom and child who needs them. I have seen copying machines used in ways such as to provide virtually instant textbooks--today's Congressional Record can be tomorrow's classroom text for a class of ten or a thousand.

"I have seen classes taught by television, and children discussing the latest exploits in space seen live on television in class or at home. I have seen students and student-teachers complete an activity and immediately see and analyze themselves on video tape. I have seen exhibits under a microscope or too small for a class to see enlarged via television so that every

student can see what the instructor is describing. I have seen students select film cartridges, insert them in individual projectors and watch a frog embryo develop, see a reenactment of a Civil War battle, or learn about a career. I have seen classes talk via amplified telephone with an expert in the field of their current interest, debate an issue with their Congressman in Washington, or exchange experiences with children in another land.

"I have seen a student engage in a dialogue with a computer to select his courses for the next year, and guidance counselors call up in an instant the full record of the student as well as relevant data comparing him with others of similar interests, abilities, and experience. I have seen administrative and record-keeping chores of schools taken over by data processing equipment, thus freeing administration and teachers for more important tasks. I have seen libraries automating their processes to provide more effective service and to keep pace with the explosion of knowledge. I have seen school buildings using the latest materials and construction techniques to provide an exciting environment for learning at a cost that any community can afford."

Kurland emphasized that much of what he had described was being operated only experimentally somewhere in the country. To get such a program into all the schools, he added, would require "major effort, much wisdom, careful planning, and not a little luck."

It Sounds Exciting, But. . .

Norman Kurland's description of the demonstrations of educational technology he had seen needs to be viewed as he viewed it--in many places across the land and often in special demonstration programs installed experimentally, with the costs met by a foundation or by other special means. It doesn't exist now in one particular city or school.

George E. Arnstein, testifying before the same Committee in behalf of the National Education Assn., drew some limits on the current status of the revolution. Arnstein was formerly associate director of an NEA project on the educational implications of automation and currently is director of Project Match, attempting to set up an automated inventory of people with professional talents and job opportunities.

He asked members of the subcommittee to assume for a moment that they were assistant superintendents of schools, instructed by the superintendent to organize computer-assisted instruction programs for their schools. "You will find, to your horror, that there is no major single source of information, no reliable agency which keeps track of all the experiments and demonstrations under way. ...There is not now in existence, anywhere in the United States, a tested, validated, usable computer-assisted teaching program which is economically competitive with 'live' teachers." He hedged a bit on that last statement, saying it was true so far as he knew. But no one called him on it, then or later.

TEACHER-STUDENT RELATIONSHIPS

Slight as have been the effects of the educational revolution so far on American education generally, introduction of the new technology has been received with hostility by many teachers, who wonder what there will be for them to do, and even more importantly, by students. The student demonstrations at the U. of California (Berkeley) are worth recalling in this connection. Conspicuous among the signs worn by Berkeley students during that protest was the oft-repeated warning: "Do not fold, spindle, or mutilate." The students were simply saying: "I am a human being. Treat me like one." A reconciliation of these protests is very much in order, because it is hard to imagine what schools would be like if they had neither teachers nor students.

One opinion on this problem was given during the subcommittee hearings in the testimony of Robert E. Glaser, professor of education and psychology at the U. of Pittsburgh and director of the Learning Research and Development Center there. In Glaser's view there will be plenty of things for plenty of teachers to do, but they will be very different things from what teachers now do. This implies they will be much better teachers and will have undergone much different training.

"The business of replacing the instructor with automation is an incorrect notion, a misconception," Glaser said. "The teacher has to become more increasingly a professional so that we do not say that anybody can teach. It is a technical job. It will become increasingly this way as educational technology develops. These people are going to get good just like physicians get good, because they are supplied with tools for their profession. This is what automation will do."

Norman D. Kurland of New York made much the same point in his testimony which he supplemented by an article he had written for the U. of the State of New York. There he said that teachers, and not facilities or curriculum, determine how well the school functions. But the task of the teacher, he went on, is becoming even more complex. Rapid advances in the technology of education, Kurland said, "have added a new dimension to teaching.... By effectively managing all the new audiovisual tools of instruction--television, teaching machines, films, and recordings--he can set up a supporting system of resources which will allow a significant variation of classroom experience and a better control over the learning situation.

"Conventional teaching must still remain a substantial part of instruction, but the understanding of the uses and limitations of new technological aids and devices permits the competent teacher to create a new organization of learning activities. All this tends to make the role of the teacher more flexible than before. It also presents a challenge to his ingenuity and adaptability.... Experimentation and innovation are likely to persist as the dominant feature for the foreseeable future."

For ideas about how the students feel about the new technology we turn to Sherman B. Chickering, president of the Moderator Publishing Co. of Philadelphia, and one of the speakers at the August 1966 Second International Conference of the American Management Assn., which was devoted to the subject, "Educational Realities." "Rapid changes are at work on the campus today,"

Chickering said. "...In fact, the gap between the campus and the board room sometimes looks like the gap between Watts and Beverly Hills, Harlem and Scarsdale, Southside and the North Shore. What this means is that unless we learn how to meet one kind of change with another, we may have a campus Watts on our hands. To my mind, the only way to avoid that possibility is to recognize two things: first, to recognize that the impact of the student on technological change is likely to be greater than the impact of technology on the student. Secondly, to recognize the modern college student.

"...The college student sees people as the new frontier, more than technology or wealth, or even outer space. Education to him means learning to live with the Joneses, not keep up with them. This means that the student is increasingly concerned with being recognized, and with its inverse, discovering other people. Hence the popular words on the campus are 'dialogue,' 'communication,' and 'participatory democracy.'"

Modern technology is viewed by the student as a means of amplifying a dehumanized approach to education, Chickering suggested. "Students don't care if you are a businessman peddling hardware, software, or underwear. They want you to help make the campus a place where people can get involved in other people, where the meaning of life is to mind other people's business."

Teaching Takes Time

Education must be concerned now with developing human beings with different kinds of attitudes and different skills from those it produced in the past. That is the message brought to the American Management Assn.'s New York meeting by Emmanuel G. Mesthene of Harvard U.'s Program on Technology and Society, of which he is the executive director.

"It is perhaps not inaccurate to say that some such proportion of the teacher's time, say 80%, has up to now been spent simply in dumping information into children's heads. The good teacher then did what he could with the balance of his time to teach the child how to use the information in his head. But things are happening with information. It is being generated in larger quantities than ever, it becomes obsolete faster than ever, and there are now technical means of storing and retrieving it far more efficient than almost any head.

"...The teacher, I am told, by and large fears the computer and computer-based learning machine as a competitor, and tends to oppose its development and adoption. Yet these devices are surely the liberation of the teacher.... Their capacity to learn is nearly infinite, and they never forget. Also, they never get tired, they never lose patience, and they never look askance and embarrass the somewhat slower student.... The teachers we admire and remember--the teachers who teach, rather than simply transmit information--are those who set standards of scholarship, who guide wisely, and who show us how to use the information that we have."

BOMBS BURSTING IN THE GHETTO

If the incipient revolution in education ever arrives at maturity it holds at least the promise of extinguishing the fire bombs that have exploded in the ghetto school districts of many cities in recent summers. That is the promise of John Henry Martin, until recently superintendent of schools at Mount Vernon, N.Y. Martin is now a special assistant to the director of the Office of Economic Opportunity. His thesis is that the existing process of teacher-directed learning had its shortcomings hidden by its massive success in assimilating polyglot peoples of largely European culture. At the same time we were indifferent to the nature of poverty, and racial distinctions kept us blind to the fact that we were not even teaching reading to Negroes, Indians, and those inhabitants in the backwoods of Appalachia.

Now that big business has decided there is a profitable market in education, Martin testified before the subcommittee of the Joint Economic Committee, the center of gravity of educational change is moving from the teachers colleges and the offices of school superintendents to the executive suites of big corporations and to their laboratories. Martin said he was praying for their success.

Criminologists and students of juvenile delinquency have found an extraordinary correlation between the offender and his inability to read. Student dropouts normally have reading difficulties and jobless adults often have the same difficulty. One reason for this, Martin suggested, is that we have made little change in methods of teaching reading from the day in ancient times when it was taught by drawing a finger in the sand or a piece of chalk on slate. Only now we use pencil and paper.

"The slum and poverty-ridden child," Martin said, "is physically handicapped, is mentally suppressed, is intellectually unfertilized to a damaging degree by the time he enters public school. This has been said often by those who would both apologize and give penance for their previous indifference.

"But the academic tragedy begins when the schools take him in.... Study after study in the cities of the United States reveal that whatever the slum child, taken in large numbers, is at age 6, he is worse by age 12. His IQ has significantly declined. His relative position to nonslum children declines even more precipitously with the passage of the years in school. Children at age 5 or 6 are doomed by the continuing pressures of a nonliterate community environment as well as by the debilitating consequences of an education unfitted to their needs. For this 'educational program' succeeds but poorly in teaching children what it seeks to teach, but ironically, succeeds too well in convincing a child of the slum that he is stupid and cannot learn and is unteachable.

"Out of this morbid milieu comes a hostility to the windows of public buildings; the fixtures in public toilets; and--when mixed with race--the white man's power structure; 'Mr. Charlie,' the policeman; and 'Whitey.'

"That despite all this, significant numbers of the ill taught learn and survive illustrates once again that nothing happens to man that cannot be used to prove that it cannot. No process is so good that hell does not receive

some of its products, and nothing is so bad that it produces only imperfections. The point of our discussion is that the schools are not now good enough."

Martin was in the fortunate position of having available to his school system half of the "talking typewriters" in the country--six--at the time he testified. Four were in use in a preschool program for four-year-olds in a city center serving 100 children, 85% of them Negro, with IQ's just above the mental retardation level. The other two were used in a hospital. All were supplied by the state, which rents them for about $1,000 a month each.

He had success stories to tell about the use of the talking typewriters in dealing with autistic children who would speak to no one. "They had been well badgered by the nature of the adult world, and had withdrawn from it," he said. But five-year-olds at the hospital, after working with the machines, are now leaving them to talk for the first time in their lives with the physicians in attendance.

He told also of an 18-year-old boy who was in a work-study arrangement, assigned to a warehouse where he had to sort materials out into various bins. But he could not read well enough even to match the labels on the materials and the bins. Martin arranged for him to use one of the talking typewriters in the late afternoons and in three months the youth was changed completely with a vocabulary in excess of 200 words, and full of self-pride.

"The machine is benign; it is neutral; it can be prostituted to use the same language of the particular didactic teacher, and, as such, it will destroy itself; but the machine responds only to what the learner does for it. He owns it. He controls it. He activates it. And for the first time the machine makes possible a concentration on the satisfactions of learning for the sake of learning itself--a thing that has almost been destroyed in our educational cultural pattern."

Head Start: A Promising Way Out?

Nursery schools and kindergartens have been hailed as the most promising way to start the education of the disadvantaged child. But only half of our public school systems have kindergartens, and almost none had a nursery school before the Head Start program began in 1965. Martin told the subcommittee that we had to assume that for children whose home life does not provide the toys and learning materials of the Head Start program, and who have never had adults read to them, these classes make an important contribution.

But we can't prove it. There is need, he said, for determining which of the many activities in which they engaged are of value; and need to determine that the fewer than 50% of American children who have experienced the kindergarten are conspicuously fewer among the dropouts, juvenile delinquents, and other school failures.

THE TARGET IS THE INDIVIDUAL

Individualized instruction has long been a cherished goal of educators--one talked about more often than it is achieved in a practical situation where one teacher is given 30 children in a classroom and told that he is expected to treat each member of the group as an individual. But the simple fact of that matter is that a group is a group and an individual is an individual, and the teacher is in charge of the group. So in actuality individualized instruction has remained, by and large, a pretty far-off objective. But if the now impending technological revolution in education ever acquires momentum, there can be real individualized instruction in the classroom. That is, assuming the students can be persuaded to abandon their "Do not fold, spindle, or mutilate" protests.

Robert E. Glaser, of the U. of Pittsburgh, made this point during his appearance before the Joint Economic Committee. The new technology will, he said, make it possible for the teacher to know at the start, through data processing, just what sort of individuals there are in the group and where each individual stands. Then a variety of materials will be available for presentation to each member of the group--through television, or moving pictures, or sound recording devices, or books. There will be a much richer world of materials through which the teacher can communicate with the student. And the student, using the new technology, will know much more about himself and where he stands than he ever did before and be in a position to make much more intelligent decisions about his future than ever before.

Glaser foresaw a priority list in the application of the evolving technology among the following groups:

- The disadvantaged.
- The very young.
- Vocational and professional education.
- Public schools generally.
- Colleges and universities.

"The public high priority seems to be one that first off will emphasize those individuals in our society who live in environments that for some reason or another deprive them of certain advantages, so that there is going to be, probably, an initial impact of the new technology of education on what we call our disadvantaged groups," he said. "...This will occur first because these groups have been neglected and are now more reachable because of the new technology with emphasis on individualization and which, of course, opens a special market for industrial people. Also related to this is emphasis on young children and early education. Again, this is being pushed, probably, because it is an untapped market. We have not done much in early education, and it is easy to sell things at this level.... It is good to train children early. We do it in schools and we sell things to the home, but I am sure that there will be the resistance of people who will say: 'Well, maybe it is a little too early.'

"Another group that is going to be influenced quickly relates to the tremendous problem of vocational and professional education because of the way things are going now and because we all feel rapidly obsolescent in our

schooling.... Somehow or other...(we) will have to update vocational and professional education for adults. Education is going to be an increasingly continuing factor. It cannot be otherwise, because knowledge moves so fast. ...We will finally make more and more impact on the general public schools, and maybe after that we will even influence the universities. Our colleges and universities may know a lot about what they teach, but they think perhaps that the methods by which they teach cannot be influenced in any way, so they are the tough nuts to crack in many ways."

Glaser, who also is a consultant to the National Education Assn.'s Division of Educational Technology, predicted the revolution is going to bring about changes in the operation of our schools. He listed some of them:

- "The role of the teacher will be restructured. It seems likely that the teacher will be able to become more concerned with individual student guidance and individual progress in addition to his role as group mentor.
- "The educators' goal of the individualization of student progress based on student background, aptitude, and achievement will come closer to realization by school reorganization and the adoption of new practices.
- "Instructional materials and devices supplied by industry will come under close scrutiny as to their instructional effectiveness, just as tests come under close scrutiny with respect to reports on their reliability and validity.
- "Mastery of subject-matter competence will be easier to obtain for a larger number of people in our schools, and tests which measure progress toward mastery will become important aids for the quality control of educational excellence.

"These developments, necessarily based on a developing body of pedagogical principles, should advance teaching toward the status of a profession, nurtured by underlying behavioral sciences which are becoming increasingly relevant to the educational process." That last point, about the behavioral sciences, brings up a new faculty job which Glaser said was going to be necessary when comes the revolution. He referred to this post as that of "instructional designer" or "educational technologist." Now, largely because of government activities, more people with scientific and technological backgrounds are becoming involved with education.

"Scientists, physicists, and psychologists are beginning to write things not only for colleges but for little children, and people who have been interested in studying behavior are beginning to worry about the application of...their disciplines to education," he said. "All of this...probably will result in a job specialty called an educational technologist. This will make a kind of job available and force a kind of individual to be trained who would almost be something like an engineer or a medical technologist who will work with a physician or a scientist...."

Increasingly as knowledge is expanded by the sciences, he added, there is an expansion of materials available for instruction. However, the schools now have no one trained to translate these new materials into something that can be handled in the classroom.

IF WE WERE STARTING FROM SCRATCH

Suppose that overnight all the schools in this country were blown out of existence, utterly destroyed. What would we build to replace them?

Such a question was posed to the group from the Joint Economic Committee by Maurice B. Mitchell, president of Encyclopaedia Britannica, Inc. of Chicago, who is also a former school board member and is now a member of the Illinois State Junior College Board. His answer was that we would build an entirely different system.

"Education is said to be the mirror of a society," Mitchell said. "Our schools do not reflect ours." He made no attempt to pinpoint the blame for this, but set some objectives for the rebuilt school system.

- Starting now, we ought to begin research looking toward a definition of what we want our school system to produce. We do not have now a clear, detailed statement of what our objective is.

- The new system ought to be able to adopt and benefit from technological innovations as quickly as commerce and industry do. The way things are, Mitchell said, our school systems receive innovations "with unbelievable slowness and frequent hostility."

There is already a mountain of research, he added, but we need more, and need especially to learn how to use it. And much of the research at hand is pointless. "A great deal of it follows the fads of the moment," he said. "If it becomes fashionable to say that the curriculum is out of date, everyone rushes out to study curriculum change; then they rush off to study teaching methods, the computer, and other new attractions. The product of this is, of course, a kind of spastic, unconstructive groping which gives us unrelated chunks of data that seem to have value, but which are not created as part of any long-range plan designed to help direct us to where we want to go in the future....

"Much of the research we see today is not really research at all. A great deal of the foundation-supported research is essentially a demonstration of what the foundations have made up their minds about in advance. Many foundations use grants to promote ideas, rather than to prove them. And the foundation grant is all around us, as a modern status symbol....

"A good deal of our research grows out of Ph.D. work. While some of the doctorate work in specialized fields leaves a great deal to be desired, and research standards are not always the highest, much of it is of value and more of it would be useful if it could be planned against an understood objective." Mitchell left the clear impression that not a great deal could be expected of the impending technological revolution in education until research has paved the way toward answers to presently unsolved questions. He conceded that the U.S. Office of Education had at least made a start in the right direction.

The computer, considered for the moment as the end product of the educational revolution, differs essentially from the human teacher in that it

has to be programed to provide precise answers and to provide such a program a great deal needs to be known about the processes of learning and teaching that the human teacher can get along without. The human teacher can progress on a trial and error basis. But when the computer, or its programmer, errs there is usually a story in the newspapers about someone who got a tax refund of $25,365,007, when all he had coming to him was $7. Mitchell drew a dreary picture of the way schools have used, or abused, modern methods of communication--the telephone, radio, television, tape recorder, etc. The first sound motion pictures were developed for classroom use in 1929, he said, but he figured at the present rate of progress another 40 years would pass before the schools really integrate them into their systems of instruction.

Instructional television he characterized as "perhaps the most expensive and disastrous single failure in the history of educational technology" although he granted its "unlimited potential." Even books are in short supply in the schools and libraries, he said, despite recent gains stimulated by federal funds.

"Overhead and other special purpose projectors, devices for tape recording and playback, instruments that can read aloud in association with printed presentations--these and many others await a status beyond the airy gimmickry with which they are often dismissed," Mitchell said. "Again some master plan approach to evaluating such products of modern research and development and getting them put to use must be launched if we want them in our teaching systems....

"Only a fraction of today's students and teachers have ever seen a programed learning unit.... In recent months the computer industry has announced its intention to enter the knowledge industry, and although this would seem at first glance to be a forward step, the reverse may well be true. The history of this frontal attack in the classroom by hardware entrepreneurs has often been a sad one, and the evidence litters the attics of schoolhouses across the country in the form of gadgets that looked good but failed because machinery itself is not a substitute for true teaching ability, because content and not presentation apparatus is essential to learning, and because no machine is worth anything in a classroom unless teachers and students have proper and continuous training in its use....

"One great opportunity for our schools lies relatively untouched--the development of systems for teaching and learning based on our newer knowledge and technical resources. Thus each entry into the knowledge business tends to be a specialized one. The movie projector people make machines. Others make films. The textbook publishers tend to ignore the existence and possible use of films and assume that their books and the teacher are the beginning and the end of learning. The tape recorder people live--and produce and sell equipment and materials--in their own closed world. The educational TV people assume that nothing has ever been produced of value to the classroom until they create it for their own cameras."

It adds up to a lot of waste and confusion and a learning system far below today's potential, Mitchell concluded. "Not much is going to happen until some force not now in existence steps in to do the job of planning and integration that the whole educational enterprise needs so badly."

WHO'S IN CHARGE HERE?

If the revolution in American education is as costly as everybody seems to think it will be, and if it requires the degree of organization and direction which the president of Encyclopaedia Britannica told Congress would be necessary, some interesting questions arise. Everyone seemed agreed that vast amounts of federal money would be involved, and while there were dissenters from Maurice B. Mitchell's appraisal of the current situation, there seemed to be agreement that some one organization had to head up the enterprise.

What then about federal control of education? "Clearly," as was suggested by Launor F. Carter, senior vice president of the System Development Corp. of Santa Monica, Calif., "the role of the federal government in this area is difficult." SDC is a nonprofit corporation concerned with computer-based information management systems. Carter is also a board member of the Educational Testing Service (ETS).

Rep. Martha W. Griffiths (D-Mich.) put the question bluntly: "...The federal government supplies the money, then you are going to run headlong into the question that the federal government is controlling education. What is what?" Carter agreed that she had raised a "very interesting issue" and "an extremely serious problem." He suggested that the only answer he knew of was to finance a multiplicity of competitive systems. But, for the benefit of keeping industry honest and giving school boards some real criteria, there had to be a dispassionate evaluation of the competing systems. ETS, he said, has recently, in association with industry, begun to set up such a system.

Mitchell suggested that "somebody"--and not Congress--was going to have to "begin to put a perimeter around these opportunities and these problems and developments and try to produce some sort of general guidelines along which we can move toward a better world of education. Otherwise, we will just move at random, zigzagging in an expensive, wasteful way."

George E. Arnstein, representing the National Education Assn. (NEA), suggested that before computers come into large scale use in the classroom they be put to work figuring out just what purpose they would serve in the classroom. For this he proposed a Bureau for Educational Technology and Administration (BETA). This would be a nonprofit corporation operating in the public interest. BETA might be sponsored by the U.S. Office of Education, he said, but once again the issue of federal control would cause difficulties.

"We need a determined effort in education to collect, index, organize, and disseminate the information, research results, and other data we already have," Arnstein added. "Through this kind of system, we will quickly uncover major gaps in our knowledge in addition to those gaps we already know about. We will be able also to eliminate a tremendous amount of duplication...which goes on and on and on when the same manpower should be devoted to...planning of the next breakthrough....

"I have not enumerated all of the areas where we need to collect and organize information nor have I been sufficiently precise in describing the kind of organization or agency which could and should carry out this challenging and difficult task. I am certain, however, that it will be cheaper to

make funds available now to channel and direct our flow of data, punch cards, information, and research than to be inundated by the continuing flow of monographs." BETA, he said, should serve the following functions:

- Provide a central file of all ongoing educational research, and accumulate the results of completed research.
- Provide an indexed and cross-reference file of computer programs and other software, with a reference to the quality of its performance, as evaluated by those who have employed it.
- Serve as a reference center so that in the absence of a suitable program it could refer an inquiring dean or superintendent to an agency which could undertake the assignment.
- Tabulate all inquiries, especially those for which it does not have answers, so that it could become a source of guidance for needed allocations in future research and development.
- Maintain up-to-date file of consultants, with telephone numbers, so that an inquirer could quickly get in touch with them.

"There are other tasks, and the list needs refinement," Arnstein said. "It may come as a surprise to you, but there are no agreed definitions, no standards, to describe (for a computer) a teacher, a child, a student, a part-time student. There is no agreed version of course descriptions and thus no compatible educational statistics.... One of the functions of BETA then would be to convene appropriate panels, to propose voluntary definitions and criteria, and to serve as a clearinghouse for their use. If we can agree on a voluntary SAE rating for motor oil, surely we can travel the same road in education so as to facilitate the use of technological innovations which thrive on compatability."

Committee Chairman Wright Patman (D-Texas) was impressed with Arnstein's testimony about the need for BETA. Referring to Arnstein's reference to a data bank operated by a nonprofit corporation supervised by educators he asked whether the NEA would qualify as the sponsoring agency. When Arnstein replied that it would, Patman responded: "That is fine. I share your views, that it should not be a government organization. ...I agree with your statement that it should be nonprofit."

What About Private Schools?

How far the federal government can go in assisting students in parochial and other private schools is a question that will have to be determined ultimately by the courts, where a host of questions are already pending. The 89th Congress made a new beginning in this subject in the Elementary and Secondary Education Act of 1965 by addressing itself to the problems of the poor. But the question is bound to rise again when, and if, the federal government undertakes the very substantial appropriations that the revolution in American education will involve. The question wasn't raised by the hearings before the Joint Economic Committee's group on economic progress. Parochial schools educate over 5 million children, about one seventh of the school population.

WHAT IS LEARNING?

The aim of the impending revolution in American education is of course to improve, by use of the computer and other devices, the spread of knowledge among students and the general population, and to assist them in the learning process. But what is learning? Ralph W. Tyler, director of the Center for Advanced Study in the Behavioral Sciences and chairman of the Carnegie Corp.'s committee which is planning a national assessment of where the country's educational system stands, undertook to supply an answer when he spoke before the American Management Assn.'s conference on "Educational Realities" in New York in August 1966.

"Learning is acquiring, through practice, patterns of behavior that one has not previously carried on; that is, one learns through experience new ways of thinking, feeling, and acting. As examples, one may learn to read, to write, to swim, to analyze quantitative problems, to enjoy classical music, to appraise social issues objectively, to paint with oils, to control one's temper, to understand some of the relations between sales volume and production costs.

"Learning is natural to human beings and the kinds of behavior they can acquire through practice are many and diverse. Correspondingly, the educational objectives of schools and colleges are varied. Even in a single subject or course, several kinds of objectives are commonly sought. For example, in reading, the student is expected to learn to comprehend the plain sense of a prose selection, to interpret reading material by bringing to bear on it ideas from other sources, to develop interest in reading a variety of good books, and to appreciate, through appropriate emotional responses, prose fiction and poetry."

Tyler had a word of warning for those too ready to exploit the new technology, before it was adequately tested. He granted that it was "the postwar wonder of the world," but pointed to educational factors that vary markedly under different conditions. Among them he cited:

- Objectives toward which the learning is directed.
- Abilities, interests, and backgrounds of students.
- Encouragement or discouragement of school learning by the environment of the school, home, or neighborhood.
- The attitudes of the student's friends and associates.
- The extent to which the technological device appropriately fits the total pattern of conditions required for effective learning.

There is much more to be learned, Tyler said, than anyone can learn in the time permitted in school. Because that time is limited, the schools must make a careful and rigorous selection of objectives, otherwise their efforts are widely scattered and little is learned. And because different schools and colleges choose different objectives, devices to aid in education must be varied. The background of the student is important, he continued, because he must do the learning, and he will practice the new behavior to the extent that he finds it satisfying. He must be interested in what he is doing, and it must be within his abilities. And the range of student abilities in most schools and colleges is quite large. "These differences

among students in abilities, interests, and backgrounds," Tyler suggested, "make it difficult if not impossible to predict in advance the extent to which a technological device will prove to be an effective aid to learning for a particular group of students."

Every environment has some effect upon the learning of those people in it by openly or tacitly encouraging some types of behavior and discouraging others, Tyler noted. There are homes and neighborhoods where intellectual curiosity is encouraged. There are others where these pursuits are frowned upon, or squelched. The attitudes of friends and associates are important, he said, because if the student's peer group labels a device as a "cold machine" or as an "escape from serious learning," that is most likely to be his view of it too.

There is no one technological device which provides all the steps in the learning process, Tyler observed, so how well any particular device will serve any particular student depends on the extent to which it appropriately fits in with several phases of the learning process. This led him, not unexpectedly, to the question of the importance of assessing the value of any proposed new device before it was put into general use. And he listed four elements that must be present in this testing, or evaluation of the device. Information must be available, he said, on:

- The student's age, sex, mental test scores, social class, educational and occupational goals, cultural level of his home, his parent's attitude toward education, his interests, types of motivation, social acceptance by peers, physical growth, and work experience.

- What the teacher has to say about his conception of the objectives, his rapport with other students, and the way he used the device.

- What external influences were at work, such as the school and community expectations of achievement and peer group values.

- How the device was related to the total learning process. Important in this connection will be the time devoted to use of the device, the rewards obtained for successful learning, and the extent of individual autonomy in the learning process.

If we have a number of experimental studies of the type mentioned, Tyler concluded, we can develop the information needed to provide a sound basis for selection of modern technological devices for use in education. "Now we have very little experimental evidence that is sufficiently analytical to guide the intelligent teacher and administrator," he concluded. "As a result, many hesitate to purchase new devices while others are selecting them because they hope to gain substantial aid in the learning process or because they have been advised by others to try them. We would not think of advising friends to use new drugs as uncritically as we often recommend new learning devices. Many of the technological developments have great potential in education but we need to find out which ones can be real aids to learning, for what, for whom, and how. Careful, comprehensive, objective evaluation is the ultimate reality on which our hopes for great improvement in education through modern technology must be based."

WHAT THE JOINT ECONOMIC COMMITTEE FOUND OUT

The Joint Economic Committee of Congress, which through its economic progress subcommittee looked into automation and technology in education, found there "the prospect of a revolution in our system of education." But the Committee made a particular point of saying, in the words of Chairman Wright Patman, that "the movement is in its early stages and there are many problems that will have to be resolved before our society can take full advantage of the new technology for educational purposes."

R. Louis Bright, Associate U.S. Comr. of Education for Research, who testified before the subcommittee, is quoted in the report as having noted that there is, in education, a tragic lag of 30 years between innovation and widespread adoption of the innovation. Bright said it takes about 15 years before the first 3% of school districts make any change.

Unless education can improve its productivity, it faces a decline in effectiveness, the Committee held. It noted that the amount of knowledge is increasing in geometric progression year after year. It quoted estimates that in the next 30 years as much new technical knowledge will be created as has been accumulated in the entire past history of mankind. New technology offers to education many new devices and combinations of devices which can speed up the educational process, the Committee said, although it recognized the validity of what it had heard from educators that cautious appraisal was required, including clear definition of the objectives of educational efforts and evaluation of proposed innovations in the light of those objectives.

"It seems clear that rapid and effective application of these devices and new techniques will require important adjustments within the educational system," the Committee found. "The role of teachers and other educational personnel may be altered. Application of the new technology will require much more specific planning for the teacher-pupil relationship, with some departures from past dependence on improvisations and intuitive insights. It could result in a considerable rise in the proportionate importance of capital equipment employed in the national educational enterprise; and this, in turn, could have significant implications for the economical and efficient size of school attendance areas and administrative districts, and the financing of education....

"In summary, it may be said that technology makes it possible to convey information in a far more flexible and, potentially at least, effective way than can be managed by an overburdened teacher, standing in front of the classroom. However, there is one big proviso: equipment must be properly programed inasmuch as its performance depends entirely on what is put into the machine. The pressing need for adequate educational 'software' to be constructively employed by the new machines was repeatedly stressed. Moreover, equipment is still highly developmental and experimental.... The testimony indicated clearly that the application of technology to education is still in an elementary stage. Much programing of teaching devices was described as poor, and the equipment in use apparently is still fairly primitive. There is great need for more research, not only on the application of technical devices, but also on the learning process itself. The subcommittee was impressed with the emphasis placed by most of the witnesses

on the need for knowing more about human psychology, particularly how the individual learns....

"In essence, the potential contribution of technology to our educational needs will be governed by the following factors:

- "Effectiveness of research in learning theory and its application to the development of education.
- "Improvement of curricular programing, particularly in respect to defining and meeting educational objectives.
- "Organization of our school systems and intelligent planning of curriculum.
- "More effective use of teachers.
- "Recognition on the part of teachers and educators of the great potential inherent in the new communications technology."

This is going to call for cooperative efforts on the part of educational institutions, government agencies, and private industry which manufactures the new devices, the report said. "They will have to collaborate both in planning and producing systems of technology that are geared to the genuine needs of the students."

One section of the final report discussed George Arnstein's proposal for the creation of an educational clearinghouse to be known as BETA. "The subcommittee is impressed with the great value that might inhere in the establishment of a data bank of this kind, utilizing the most advanced data processing and communicating techniques and equipment," the report said.

And it closed with a note of warning to overly ambitious manufacturers. "It is obvious that major corporations have moved into the field of educational technology and that in some cases, through default, they have taken over the crucial function of preparing the content of educational programs.... It would be tragic if control of curriculum and the content of courses were to pass into the hands of large corporate producers.... It is imperative that educators maintain and safeguard their proper role as formulators of educational policy. In the years ahead, it should be a primary concern of public policy to safeguard this role."

Adult Education

With 11 million Americans classed as functional illiterates, most of them burdens on society rather than contributors to it, the Joint Economic Committee was particularly concerned with what the new technology holds for them. "There are convincing indications," the final report said, "that imaginative application of existing technology can do much to facilitate progress in overcoming illiteracy, and it is hoped that research and pilot projects will concentrate more on this subject than they have to date. ...This subcommittee recommends that the Administration...submit to the Congress at an early date a coordinated program for achieving that objective."

WHAT YOU DON'T KNOW CAN HURT YOU

A simple but devastating explanation of why the revolution in education has made so little progress in the nation's schools is offered in a new book, Computers and Information Systems in Education, by John I. Goodlad, professor of education at the U. of California (Los Angeles), and others. They find the primary factor to be ignorance on the part of people in high administrative positions of what it is all about. Most of today's decision-makers in education, they point out, were born and formally educated before there were computers, and, in this matter at least, just haven't kept up with the times.

There are, of course, many other obstacles, including who's going to put up the money, our tradition of local control of the schools, and many unanswered questions about the software--questions which have been outlined earlier in these pages. But Goodlad and his fellow authors return again in their brief book to the subject of ignorance on the part of school decision-makers concerning what automation can do for them and their schools. After mentioning the money problem they add: "There is also a serious lack of knowledge on the part of educators about the power and potential of computer systems for improving educational programs. Probably the most important reason for the slow diffusion of computer applications in education is the poor dissemination of results already being achieved by successful installations.

"School personnel in general do not know what computers and data processing systems can do for them. However, from the experience gained in the military, business, and science fields, it seems likely that growth in understanding and an increasing knowledge of existing installations soon will break down resistance in education. Utilization of educational data processing (EDP) systems should then increase rapidly."

According to the American Council on Education, there were computers on 600 campuses in 1966, and the prediction is that they will spread to 1,100 campuses by 1970 (some campuses have more than one computer--the National Academy of Sciences estimates that there were 800 computers in higher education in 1966). A 1966-67 survey conducted by the Assn. for Educational Data Systems shows 800 school districts with computers in 1966 and a predicted 1,500 computerized school districts by 1970.

"Most educators still use relatively primitive techniques for processing the wide variety of information required in the daily operation of schools," Goodlad and the other authors say. "Using papers, pencils, and typewriters, they produce a vast number and variety of records and reports pertaining to students, teachers, budgets, and accounting transactions. Endless hours and professional energies are consumed in routine clerical work that could easily be taken over by a computer. Some attention is now being given to computer applications in instruction, research, school administration, guidance, and related elements of the educational program. However, these are so limited in number that they must be considered experimental."

The book contains an appendix which identifies 27 educational agencies and institutions around the country which are in one degree or another using automated data processing equipment. These 27 were chosen as representative of the broad classification, varying widely in the sophistication of their

hardware, as well as in size and the political level of the population they serve, ranging from a state which serves 1,600 school districts to a school district with only 7,000 pupils. Purpose of the material presented is simply to provide a sample and supply sources for further inquiry.

Teachers do not escape the ignorance indictment which the book levels at school decision-makers. "As we move today toward individualized programs facilitated by new patterns of school organization and comprehensive packages of instructional materials," the authors say, "the pupil diagnoses and prescriptions called for demand new data and more sophisticated use of them. Most teachers have not yet either perceived or been prepared for the kinds of decisions they will increasingly be called upon to make. Furthermore, they usually do not yet see the inherent possibilities of the many items of information now available. It is imperative, therefore, that educators stay very close to the tasks of defining, collecting, and providing the data needed. Otherwise, EDP personnel are likely to develop systems that perpetuate the provision of data pertinent to the relatively routine educational tasks of the past but inappropriate to sensitive educational decisions of the future.

"A new kind of school is emerging, calling for new kinds of data about students and their learning and for the closest collaboration of educator and information specialist in collecting these data. To advance this collaboration, we recommend that support be given to projects seeking to couple automated data processing techniques with the development of innovations in scheduling, counseling, school organization, curriculum development, and instruction. Such projects may well reveal how 'the new school' might look if a whole range of educational changes were to be introduced simultaneously. If, for example, individualized instruction is to become more than a slogan," the authors say, automatic data processing must be relied on. And they refer to this as "a tall and expensive order, since it centers upon the use of EDP for opening up fresh possibilities in what is now a primitive part of the educational enterprise."

What To Do Now

Among a number of recommendations in "Computers and Information Systems in Education," is that there be established a national central clearinghouse for promoting exchange of technical information and materials, letting educators know "who is doing what where." Such a proposal was made by an NEA spokesman to the Joint Economic Committee, and was approved by the Committee in its report to Congress. The suggestion is made in Computers and Information Systems in Education that this function be assigned either to the U.S. Office of Education or to the National Education Assn. Apparently a private, nonprofit group is stepping in to fulfill this service. The Educational Products Information Exchange (EPIE), an offshoot of the Institute of Educational Development (IED), has begun to develop a national clearinghouse for information on equipment and learning materials. Launched in November 1966, EPIE is directed by P. Kenneth Komoski; its headquarters are at 200 Park Ave., New York City 10017.

THE NEGRO STUDENT

The report of the National Commission on Technology, Automation, and Economic Progress, of which Howard R. Bowen, president of the U. of Iowa, was chairman, dealt only incidentally with automation in education, but addressed itself to the vastly broader social and economic question of where automation will take us in the next 10 years and what we should do about it. The report did, however, devote a chapter to education, regarding it chiefly as a contributor to the nation's labor force. It noted at the outset that the goals of education in terms of development of individuals as persons and as responsible citizens far outweigh education's economic objectives.

"A considerable amount of experimentation and research in applying computer and information technologies to educational problems is under way," the report said. "Much of what is being done bears on compensatory educational techniques for disadvantaged people in the labor force and on development of a system of continuous, lifelong education."

The report noted that it had been far too common in the tradition of mass free education to attribute its failures to the inadequacy of individuals, rather than to change educational techniques to meet the needs of student failures, or to overcome their limitations. "They do nothing for those in and out of school who cannot make effective use of established patterns and approaches to education," the report said. It expressed the pious hope that the new technology of education would remedy that situation.

When it got around to discussing educational attainments of the labor force, the Commission dealt with a situation it described as "shocking." It found that of all "nonwhites" (mainly Negroes) in the labor force aged 18 years and older in 1965, 37.6% had only an elementary school education, compared with 21.6% of the whites. There were 37.5% among the Negroes who had completed high school, against 60% of the whites. And only 7% of the Negroes had at least 4 years of college, while the figure for whites was 12.2%.

"The gap between white and Negro educational attainment," said the Commission, "measures not only the long oppression of the Negro but an economic loss to them and to American society. The problems are especially severe among older Negro workers, but the gap exists at all ages. It must be closed.

"It is inevitable in a society where educational standards are improving that the young will be better educated than the old. But the educational disadvantages of Negroes are not inevitable, although they are real and tragic. And because workers of low educational attainment are least desirable to employers, nonwhite and older workers are concentrated at the rear of the line, not only because of their lower educational attainment, but also because of direct discrimination. Nevertheless, whatever the level of economic activity, whatever the extent of the pressures of demand on employers to seek further down the education and skill ladder, and whatever other hiring standards are used, education and training can improve the ability of people with competitive disadvantages to compete effectively in the labor market."

The Commission, picturing the labor market as a queue, with employers picking off the front of the line the most qualified, through education and

training, said there was another possibility--"begin at the rear of the line and create employment opportunities tailored to the abilities of those with serious competitive disadvantages.

"We are impressed with the extent to which recent policy has been designed to do exactly that," the report said, mentioning the war on poverty and the New Deal public works programs as examples. It compiled a table listing under six categories (the national beautification program, medical institutions and health services, and educational institutions led the list) where the federal government might employ people for newly created jobs, making its selection from the tail end of the employment queue. Each of the three categories mentioned accounted for more than a million new workers out of a total in all categories of 5.3 million. "The principle of such public service employment has been implicitly endorsed in existing programs," the report said. "We recommend that the concept be expanded and made explicit as a permanent, long-term program." In its other recommendations on education, the Commission avowed its approval of better education at all levels, from the nursery school through the university. It said that high school graduation should become universal and that all qualified students, whatever their financial standing, should have access to university education.

"It is our firm conviction," the report concluded, "that educational opportunity should be open to all. A first principle of a progressive and humane society is that no person shall be deprived by financial barriers or by barriers of ethnic or national origin, religion, age, place of residence, or background of the opportunity for maximum growth and development through education.... The need is greatest among the culturally deprived, and special emphasis should be given to education for these groups. Significant progress toward this goal has been made in recent years, but neither accomplishments to date nor concrete plans for the future are sufficient to achieve fully what must clearly be a national goal of highest priority."

The Games Disadvantaged Students Can Play

Groundwork for the Commission's chapter on education was laid in a separate volume, Educational Implications of Technological Change, published as an appendix. This is a report on 35 current research and development programs which apply computer technology to educational problems. Although the computer's present use is mainly in administrative matters it is apparent, as this appendix reports, that its future potential lies in instructional activities. First of 12 recommendations in the appendix is that there be a major effort in developing games as educational devices for reaching disadvantaged students. Another recommendation is that researchers change in their approach. Many still cling to the formal hypothesis testing approach even after repeated demonstrations of its limited usefulness in gaining meaningful insights into the dynamics of education. Instead, the report says, they should seek repetitive cycles of testing and modification, using "behavioral engineering" to discover appropriately tailored instructional materials.

A WORD FROM COMMISSIONER HOWE

U.S. Comr. of Education Harold Howe II had a word of warning for businessmen gathered at the American Management Assn.'s New York meeting on "Educational Realities." They weren't about to waltz down Easy Street in entering the $50-billion-a-year education market presenting sophisticated machinery to unsophisticated buyers, he said. Research had already shown that tomorrow's schools are going to be very different from those we know today. But before the invasion of education by business can succeed, Howe said, we need answers to some important questions.

He noted that we spend proportionately 20 times more on health research than on educational research, and 60 times as much on defense research, and that the new technology in American education was largely a by-product of what we have learned through research in other fields. We know now that we have barely scratched the surface of man's ability to learn, and that there is a vast potential for change at every level of American education, he agreed. But answers to some very specific questions are going to have to come first before the revolution can get very far. He listed some questions demanding answers:

- How can we reach the children of the slums, who have remained relatively untouched by traditional education?
- How can we find out, for any group of youngsters, whether we are teaching them the right or wrong things?
- Can those who learn well learn even more?
- How can we decide, in view of the explosion of knowledge, what part of the whole field we ought to attempt to teach?
- How do we reach those presently unmotivated to learn?
- How do we evaluate and alter school organization?
- How do we come to a real understanding of what intelligence is? And can intelligence be learned?
- At what age should formal education begin? And do parents have a real job to do in this connection?
- Do all children require individualized instruction?
- How much should we be involved in the education of peoples of other countries?
- How do we improve the education of two million teachers without seriously interrupting their teaching careers?
- How can we get the most out of the individual student's ability to teach himself?

"It seems clear that technology can help us deal with some of these matters--as a research instrument and in instruction," Howe said, "but how it can and should do so still defies us. The somewhat unhandy fact is that we have to be smarter than the machines in order to figure out what the machines ought to do.... Sophisticated computers may eventually help us answer some of education's hard questions, and they will undoubtedly be programed to present conventional subject matter very effectively. The essence of education, however, is beyond the capacity of a machine, and always will be.

"A computer cannot develop a student's ability to associate effectively

with other people. It cannot train a pupil to originate ideas, to present them, and defend them against criticism, or to talk confidently before a group. It cannot foster creativity, stimulate thought, encourage experimentation, teach students to analyze. ...Education will never ultimately lend itself to self-service operation.

"No matter how effectively computers are used in the classroom, they do not really teach anything. It is the program that teaches--a program designed by a teacher. I suspect that the fundamental outcome of educational technology will be to free the teacher from the robot role of standing in front of a classroom presenting routine material. Rather, he will become the source of intellectual stimulus, the leader of discussion groups that cause students to think and probe and express their ideas effectively.

"One outcome of this kind of relationship will be a great deal more interaction between individual students and the teacher than can now be provided by the conventional classroom. At present, students receive genuinely personal attention only a small portion of the time. The student in tomorrow's computerized school will probably receive far greater personalized attention and much more interaction with teachers than he now experiences."

The temptation has been to jump the gun, Howe warned, and the combination of "fast-buck salesmanship" and a schoolman's "eagerness to latch on to the latest ideas" is already painfully apparent in the U.S. Office of Education. He quoted one paragraph from a background paper prepared for a university seminar on business and education:

"The real question here is not what is new, but rather, how can the new best be used? Unfortunately, our answer to this question has frequently been partial or expedient, rather than complete or responsible. For example, the so-called new media--television, teaching machines, and the like--have frequently been prematurely introduced before either adequate content or reliable evaluation has been available. The result has been all too often a wave of hasty enthusiasm for the promise of a new technology or device, followed by a more leisurely repentance when it fails to live up to its billing. Such an outcome is not necessarily the fault of the media or devices involved, but the natural human desire for quick and easy solutions that leads us to hasty action."

Howe made the point that some schools even now are making thoughtful and effective use of the new instruments presently available. "But it is important to remember the abuses, as well as the responsible uses," he added.

"...The new education just emerging will increase the child's opportunity to get facts from things and values, subtleties, and interpretations from people," he concluded. "The role of the teacher is changing, and the kinds of materials needed are changing accordingly. The ultimate and massive market is not equipment and materials for classes of children but equipment and materials for individual children learning at their own rates and set free from the lockstep of the standard group. Incidentally, the business firm able to make something that would be useful in a school library is clearly in the wave of the future, for the library is the fastest growing element in the modern school."

THE NEXT STEP

Those wanting to keep up to date on the problems of school automation have several resources, some of them founded very recently.

Already mentioned (p. 19) is the Educational Products Information Exchange, started by a grant from the U.S. Office of Education. It hopes to become self-supporting within a few years through fees paid by school administrators for information on educational materials. It will not attempt to evaluate devices or materials, but will give educators the latest information on how particular products met particular needs of particular schools as reported by the schools themselves. It will conduct trial runs early in 1967 in a few school systems of one or two items which have gone through EPIE processing.

Also mentioned earlier is a membership group, the Assn. for Educational Data Systems, founded in 1962 (1201 16th St., N.W., Washington, D.C. 20036). AEDS has established a National Center for Educational Data Processing which serves as a central depository of documented procedures and programs, conducts seminars and workshops, handles a personnel placement service, and is working on an information clearinghouse. AEDS has two periodicals of interest in this field: AEDS Monitor, a monthly newsletter which scans developments at individual districts and campuses as well as at the national level, and Journal of Educational Data Processing, a quarterly publication. AEDS also offers upon request a 64-page, very comprehensive "General Resource List for Educational Data Processing."

Other groups concerned with educational technology include:

Division of Educational Technology of the National Education Assn. (1201 16th St., N.W., Washington, D.C. 20036). This Division has been particularly active in the developing area of 2500 megacycle television, consideration of educational use of a satellite communication system and the question of by whom a system might be realized and financed, implications of proposed changes in the copyright law on use of copyright materials for teaching and learning, programed instruction, instructional uses of the computer, and development and use of instructional systems and systems analysis.

The Committee on Educational Data Systems, established by the Council of Chief State School Officers to develop techniques for assimilating useful information on data processing for a nationwide pool. The Committee, one of two prominent committees of the Council of Chief State School Officers, is composed of one person knowledgeable in the field of data processing appointed by each state chief officer. It works closely with the U.S. Office of Education and all other agencies in the development and improvement of data processing, sharing and improving the flow of information, and coordinating efforts of those collecting information on data processing. Although not a membership group, it produces an annual report which might be of interest to those working in the field of educational data processing. For further information contact Council of Chief State School Officers, 1201 16th St., N.W., Washington, D.C. 20036.

Bibliography

Automation and Technology in Education. A Report of the Subcommittee on Economic Progress of the Joint Economic Committee, Congress of the United States. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1966. 11 pp. 10¢. (Y4.EC7: ED8/2)

Goodlad, John I.; O'Toole, John F., Jr.; and Tyler, Louise L. *Computers and Information Systems in Education.* New York: Harcourt, Brace & World, 757 Third Ave., 1966. 152 pp. $4.50.

Technology and the American Economy. Report of the National Commission on Technology, Automation, and Economic Progress. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1966. 115 pp. 75¢. (Y3.T22: 2T22/V1)

Educational Implications of Technological Change. Appendix Volume IV to *Technology and the American Economy* (listed above). Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1966. 151 pp. $1. (Y3.T22: 2T22/APP/V4)

Technology in Education. Hearings before the Subcommittee on Economic Progress of the Joint Economic Committee, Congress of the United States. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1966. 273 pp. 65¢. (Y4.EC7: ED8)

Other current sources

Bushnell, Don D., and Allen, Dwight W. *Computers in American Education.* New York: John Wiley & Sons, 605 Third Ave., 1967. Approximately 380 pp. (In press)

Flanagan, Dennis, editor. "Information" (with special reference to how it is processed by computers). *Scientific American* 215: 3-316; September 1966. 60¢.

Glaser, Robert, editor. *Teaching Machines and Programed Learning II: Data and Directions.* Washington, D.C.: Department of Audiovisual Instruction, National Education Association, 1201 Sixteenth St., N.W., 1965. 831 pp. $11.50.

Kaimann, Richard A., and Marker, Robert W. *Educational Data Processing: New Dimensions and Prospects.* Boston: Houghton Mifflin Co., 2 Park St., 1967. Approximately 250 pp. (In press)

Lieberman, Myron, guest editor. "Big Business, Technology, and Education." *Phi Delta Kappan* 48: 185-248; January 1967. 60¢.

Loughary, John, editor. *Man-Machine Systems in Education.* New York: Harper and Row, 49 E. 33rd St., 1966. 242 pp. $4.50.